across the eye box such that no perspective change is observed by the user as their eye transitions through the eye box, and may allow rendering of virtual objects at any desired depth from the user (e.g., thus solving accommodation-vergence mismatch). Multi-layer holographic combiner **40** may also pass real world light **30** to eye box **24** (e.g., for overlaying real world and virtual images).

[0044] FIG. **3** is a diagram showing how transmission hologram structures **44** may replicate each ray angle from input light **56** towards reflection hologram structures **42**. In the example of FIG. **3**, two illustrative rays **56-1** and **56-2** of input light **56** (FIG. **2**) are shown for the sake of clarity. Ray **56-1** hits transmission hologram structures **44** at incident angle A**1** whereas ray **56-2** hits transmission hologram structures **44** at incident angle A**2**. Transmission hologram structures **44** may replicate ray **56-1** and ray **56-2** at one or more output angles (e.g., as shown by light **60**).

[0045] The transmission holograms in transmission hologram structures **44** may be configured to diffract light from different incident angles and wavelengths at corresponding output angles. The spacing (frequency) of the grating used to form each hologram (e.g., the spacing in refractive index modulations in the holographic medium used to form structures **44**) configures that hologram to diffract light of a given wavelength and from a given incident angle at a corresponding output angle (e.g., when the input light is Bragg-matched to the grating). The set of transmission holograms used to form transmission hologram structures **44** may include any desired number of holograms (gratings) having corresponding grating frequencies and orientations (e.g., for diffracting incident light at any desired number of incident angles and wavelengths at any desired number of output angles). Each transmission hologram in the set may be superimposed on the same volume of holographic medium or different transmission holograms in the set may be formed in any desired number of discrete layers.

[0046] In the illustrative example of FIG. **3**, the set of holograms in transmission hologram structures **44** include a first transmission hologram configured to diffract light from incident angle A**1** (e.g., ray **56-1**) at output angle B**1** (as shown by ray **60-1**), a second transmission hologram configured to diffract light from incident angle A**1** at output angle B**2** (as shown by ray **60-2**), a third transmission hologram configured to diffract light from incident angle A**1** at output angle B**3** (as shown by ray **60-3**), a fourth transmission hologram configured to diffract light from incident angle A**1** at output angle B**4** (as shown by ray **60-4**), and a fifth transmission hologram configured to diffract light from incident angle A**1** at output angle B**5** (as shown by ray **60-5**). In this way, transmission hologram structures **44** may split ray **56-1** into five replicated beams that are transmitted towards reflection hologram structures **42**.

[0047] At the same time, the first transmission hologram in transmission hologram structures **44** may diffract light from incident angle A**2** (e.g., ray **56-2**) at output angle B**1** (as shown by ray **60-6**), the second transmission hologram may diffract light from incident angle A**2** at output angle B**2** (as shown by ray **60-7**), the third transmission hologram may diffract light from incident angle A**2** at output angle B**3** (as shown by ray **60-8**), the fourth transmission hologram may diffract light from incident angle A**2** at output angle B**4** (as shown by ray **60-9**), and the fifth transmission hologram may diffract light from incident angle A**2** at output angle B**5** (as shown by ray **60-10**). In this way, transmission hologram structures **44** may split ray **56-2** into five replicated rays that are transmitted towards reflection hologram structures **42**. This example is merely illustrative and, in general, transmission hologram structures **44** may include any desired number of holograms for splitting rays **56-1** and **56-2** over any desired number of output angles.

[0048] The first through fifth transmission holograms may be superimposed with each other across the entire length of transmission hologram structures **44** if desired. In another possible arrangement, the first through fifth transmission holograms may be recorded in partially overlapping or non-overlapping regions of transmission hologram structures **44**. These transmission holograms or additional transmission holograms in transmission hologram structures **44** may be configured in this manner for replicating (splitting) the incident light from any desired number of incident angles (e.g., across the field of view of the projector) at output angles B**1**, B**2**, B**3**, B**4**, and B**5**. This may serve to replicate pupils that are focused onto eye box **24** (FIG. **2**) by reflection hologram structures **42**. In the example of FIG. **3**, operation on light of a single wavelength is shown for the sake of clarity. If desired, the number of holograms in transmission hologram structures **44** may be multiplied for each wavelength of light that is projected onto multi-layer holographic combiner **40** (e.g., the transmission holograms may be color multiplexed).

[0049] FIG. **4** is a diagram showing how reflection hologram structures **42** may focus the light replicated by transmission hologram structures **44** towards eye box **24** (FIG. **2**). The example of FIG. **4** only shows the operation of reflection hologram structures **44** on diffracted rays **60-3**, **60-4**, **60-8**, and **60-9** of FIG. **3** for the sake of clarity. In general, reflection hologram structures **42** may include additional holograms for handling each diffracted ray from transmission hologram structures **44**.

[0050] The reflection holograms in reflection hologram structures **42** may be configured to diffract light from different incident angles and wavelengths at corresponding output angles. The spacing (frequency) of the grating used to form each hologram (e.g., the spacing in refractive index modulations in the holographic medium used to form structures **42**) configures that hologram to diffract light of a given wavelength and from a given incident angle at a corresponding output angle (e.g., when the input light is Bragg-matched to the grating). The set of reflection holograms used to form reflection hologram structures **44** may include any desired number of holograms (gratings) having corresponding grating frequencies and orientations (e.g., for diffracting incident light at any desired number of incident angles and wavelengths at any desired number of output angles). Each reflection hologram in the set may be superimposed on the same volume of holographic medium or different reflection holograms in the set may be formed in any desired number of discrete layers.

[0051] In the illustrative example of FIG. **4**, the set of holograms in reflection hologram structures **42** include a first reflection hologram in region **62** that is configured to diffract light from incident angle B**3** (e.g., ray **60-3**) at output angle C**1** (as shown by ray **55-1**) and a second reflection hologram in region **62** that is configured to diffract light from incident angle B**4** (e.g., ray **60-4**) at output angle C**1** (e.g., towards eye box **24** of FIG. **2**). While not shown in the example of FIG. **4** for the sake of clarity, additional reflection holograms may be recorded in region **62** for diffracting